CRITERIA FOR THE SELECTION OF PROTECTIVE CLOTHING FOR FIRE INVESTIGATORS

EXECUTIVE DEVELOPMENT

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ABSTRACT

The Tulsa Fire Department is actively involved in determining the origin and cause of fires through fire scene investigations. The problem was the department had no recognized criteria for the selection of protective clothing used by fire investigators during fire scene investigations. The purpose of this research was to identify criteria by which the department can base the selection of protective clothing for the investigators.

Action research methodology was utilized to answer the following research questions: (a) whether the nationally recognized standards for fire department operations address the issue of protective clothing for fire scene investigators, (b) what are the recommendations of authoritative references for fire scene investigation concerning protective clothing, (c) what are the fire investigators from other agencies using for protective clothing during fire scene investigations, and (d) what criteria are other organizations involved in fire investigation using to select protective clothing for fire scene investigators.

The procedures included a review of the published literature addressing the research questions and the use of a survey instrument to determine the procedures and opinions of others involved in fire investigation. The results of the survey and literature review were evaluated and used to establish selection criteria.

The results were the nationally recognized standards do apply to the selection of protective clothing for fire investigators by requiring an assessment of the risks of a fire scene and then the use of appropriate protective clothing. Most of the authoritative references for fire investigators avoided making specific recommendations about design characteristics of protective clothing for fire investigators, but they did reference the need to follow the requirements of applicable standards. The survey established the majority of fire investigators

from other agencies are not basing the selection of their protective clothing on applicable standards, but do have recommendations concerning criteria for the selection of protective clothing for fire investigators.

The recommendations resulting from this research included: (a) adhering to the requirements of the applicable nationally recognized standards, (b) supplying fire investigators with a variety of protective clothing to provide the required levels of protection, (c) using the identified criteria from other agencies to determine the selection of protective clothing, and (d) continued research into the availability of protective clothing meeting the identified criteria.

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INTRODUCTION

The Tulsa Fire Department is charged with the responsibility of investigating all fires occurring within the city limits. Although some minor investigations are performed on the company officer level, the investigation of all major fires is the responsibility of the Fire Investigation Division of the Fire Marshal's Office. While the protective clothing worn by firefighters during the course of firefighting duties is now strictly regulated by the national standards, it is unknown whether the same is true for the uniform/protective clothing of the fire scene investigator. The Tulsa Fire Department would like to provide appropriate protective clothing to the investigators in order to assure the safety and comfort of the investigator as well as a complete and successful investigation. The problem is the Tulsa Fire Department has no identified criteria for the selection of protective clothing used by fire investigators during fire scene investigations.

The purpose of this applied research project is to identify criteria by which the Tulsa Fire Department can base the selection of protective clothing for fire scene investigators. Action research methodology will be used to answer the following research questions:

1. Do the recognized national standards regarding fire department operations address the issue of appropriate protective clothing for fire scene investigators?
2. What are the recommendations of authoritative references for fire investigation concerning appropriate protective clothing for fire investigators?
3. What are the fire investigators from other agencies using for protective clothing during fire investigations?
4. What criteria are other organizations using to select protective clothing for fire scene investigators?

BACKGROUND AND SIGNIFICANCE

Background

This research is conducted to develop criteria for the selection of protective clothing for the fire scene investigators assigned to the Fire Marshals Office of the Tulsa Fire Department.

At present, without identified selection criteria, the fire investigators are utilizing a variety of protective clothing during the processing of fire scenes. Fire resistant coveralls, fire fighting turnout gear, and insulated cotton coveralls are provided to each investigator. However, there are no identified criteria for selecting appropriate protective clothing for fire investigation or for determining what protective clothing will be worn at a particular incident. No effort has been made by the department to identify desirable design criteria of protective clothing for the purpose of fire scene investigation. It is also unclear whether the protective clothing worn by fire investigators, investigating fire scenes after all active fire has been extinguished, is subject to regulation by the nationally recognized standards.

The department recognizes research must be done to determine if proper protective clothing is currently provided to the investigators. It is not reasonable to allow the present situation of uncertainty to continue when safety, liability, and productivity issues are unanswered. The department must consider what type(s) of protective clothing should be provided, what are important selection criteria of that clothing, what policies and standards should apply to protective clothing usage, and what are the liability issues associated with the selection of protective clothing for investigators. Failure of the department to define the issues influencing the selection of protective clothing for fire scene investigators may place the department, and the City of Tulsa, in a position of liability which is both unwanted and unnecessary.

Significance

This applied research project is part of the requirement for completion of the June 2000 *Executive Development* course offered at the National Fire Academy in Emmitsburg, Maryland. One of the content areas of the course is *Unit 10: Service Quality/Marketing* (National Fire Academy, 1998). This research is relevant to that content area because successful fire scene investigations provide information about the fire problem in the community. The information is used as the basis of fire prevention. Dan Runnestrand, Chief Investigator for the Orange County California Fire Authority, explains the importance of fire scene investigations in an article stating fire investigation is "an essential customer service" (Runnestrand, 1997, p. 44). Runnestrand goes on to state:

> The fire service has long emphasized that our first priority is prevention. The accurate and thorough investigation of fires provides the foundation for any effective prevention efforts. Without a thorough understanding of fire cause, any intervention strategy to prevent fires will be groping in the dark. Code changes, product improvements and public awareness are just some of the effective interventions that receive crucial input from fire investigation. (p. 44)

Providing investigators with the tools they need, including appropriate protective clothing, will help attain accurate and thorough investigations. The information learned from fire investigations can be used to direct fire prevention efforts and benefit the community.

LITERATURE REVIEW

The literature review for this research started at the National Fire Academy's Learning Resource Center and continued upon the researcher's return to the Tulsa Fire Department. This researcher and the staff of the Learning Resource Center collected published literature on the topic. The goals of the literature review are to discover what information is available concerning the issue of protective outer clothing for fire scene investigators and to determine how the topic is addressed by the nationally recognized standards.

Runnestrand (1997) points out fire scene investigators provide a service to the community and the beneficial results of their investigations should be used as a marketing tool in the community's political arena. He goes on to stress fire investigation is the basis of any fire prevention effort; "it's the vital link between historical fires and the prevention of future fires" (p. 44).

Risk Assessment

Munday (1995) notes that fire investigation is a hazardous, dirty task and all investigators should attempt to minimize the risks associated with the scene examination. A concern of Geraci (1997), in an article addressing the hazards of fire scene investigations, is fire investigators are not fully considered by the incident commander or the safety officer at the fire scene. He therefore recommends the investigator conduct an evaluation of the hazards of the structure before an investigation begins. This concept of a *risk assessment* is echoed by many of the authors writing about fire investigation safety. Williams (1997), Munday (1995), Lacy (1995), and Churchward (1995) have all authored articles where the importance of a risk assessment prior to the investigation is presented. The *Fire Investigation Unit Management Guide*

(Maryland Fire and Rescue Institute [MFRI], 1997) devotes chapter eight to risk management and the resulting ramifications of the risk assessment performed at the scene.

The International Fire Service Training Association (IFSTA) *Fire Investigator* (International Fire Service Training Association [IFSTA], 2000), an educational text for fire investigators, directly references NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*. NFPA 1500 is a document of paramount importance in today's fire service since it prescribes the requirements for safe fire department operations. This document requires the fire department adopt a risk management plan in which "…the risks associated with the operations of the fire department are identified and effectively managed" (NFPA, 1997a, section 2-2). The risk assessment required in NFPA 1500 and the resulting determination of what hazards are present at a scene are vital factors in determining what protective clothing is required for an investigation.

Do the National Standards Apply and How?

The literature review finds different paths leading to the answer as to whether the national standards apply to protective clothing for fire scene investigators. An important initial issue determining how the standards influence the fire investigator is whether the investigator is working for a private sector entity or employed by a public organization. For the purposes of this research, it should be remembered that fire investigators employed by the Tulsa Fire Department are public employees.

Howicz (1995) writes a comprehensive article describing how the federal safety regulations provided by the Occupational Safety and Health Administration (OSHA) apply to the fire investigator. He initially explains OSHA regulations apply only to private companies or to the 25 states and territories that have adopted OSHA on a state level. However, Howicz goes on

to explain some states, although not officially listed as OSHA states, have used OSHA regulations as the basis for their programs. Oklahoma is one of those states.

Although not officially an OSHA state, the Oklahoma Department of Labor has adopted Federal OSHA Regulations, specifically 29 Code of Federal Regulations (CFR) 1910, *Federal Occupational Safety and Health Standards for General Industry* into state law (Oklahoma Occupational Health and Safety Standards Act, Rev. 2000). The end result is the same as if Oklahoma was an OSHA state. Therefore, 29 CFR 1910 applies to Tulsa Fire Department operations.

OSHA Standards

Most authors (MFRI, 1997; Geraci, 1997; IFSTA, 2000; Lacy, 1995; Howicz, 1995; and Churchward, 1995) reviewed note applicable OSHA standards for fire scene investigators. One of the most cited is 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*, or *Hazwoper* (Occupational Safety and Health Administration [OSHA], 1994b). Hazwoper "requires all personnel, including fire investigators, engaged in hazardous waste site operations or response activities at locations where hazardous substances are present, must be properly trained and certified prior to engaging in such activities" (MFRI, 1997, p. 8-9). Hazwoper further requires an examination of the scene to determine the hazard level present (OSHA, 1994b, section [c][5][i]). Then, the appropriate personal protective equipment (PPE), including protective clothing, can be selected for the scene (section [c][5][iv]).

The selection of the appropriate protective equipment is determined from Appendix B of 1910.120 (OSHA, 1994a). The available protection options range from *Level A*, which is the most protective, to *Level D*, which is the least protective and is worn when "the atmosphere contains no known hazard…" (OSHA, 1994a, p. 6). Appendix B of 1910.120 explains the

concept of *levels* of hazard and the corresponding appropriate levels of protective clothing. This relationship is a key factor in determining what protective clothing should be provided to investigators. Level A requires a "totally-encapsulating chemical-protective suit" and self contained breathing apparatus (SCBA) (OSHA, 1994a, p. 2). Level B is less restrictive but still requires SCBA and "hooded chemical-resistant clothing" (p. 3). Level C allows the use of air purifying respirators instead of SCBA but still lists hooded chemical-resistant clothing as a requirement. Finally, Level D requires only "a work uniform affording minimal protection: used for nuisance contamination only." (p. 4). Coveralls are noted as an example of Level D protective clothing.

Mike Mallory, Safety Officer for the Tulsa Fire Department, informed this researcher his interpretation of 1910.120 Appendix B is that in some instances firefighting bunker gear qualifies as Level C protective clothing since they are designed to be somewhat chemically resistant (M.J. Mallory, personal communication, October 25, 2000). He emphasized the particular incident will dictate whether more chemically resistant clothing is required. Mallory stated the coveralls presently worn by Tulsa Fire Department investigators qualify only for Level D protection.

According to the *Fire Investigation Unit Management Guide*, other OSHA standards that may be pertinent to fire investigation include *Personal Protective Equipment* (29 CFR 1910.132 -1910.138), *Electrical Safety Work Practices Standard* (29 CFR 1910.331-1910.335) and *Bloodborne Pathogens Standard* (29 CFR 1910.1030) (as cited in MFRI, 1997, pp. 8-10, 8-11). The *PPE* standard addresses the employer's responsibility to provide appropriate protective clothing to employees. The *Electrical Safety Work Practices Standard* requires investigators be properly trained and protected when working where electrical hazards may be present. The

Bloodborne Pathogens Standard is of interest because it deals with scenes where there may be infectious materials present, such as fatality fire scenes or explosions.

NFPA Standards

In addition to applicable OSHA standards, several of the Voluntary Consensus Standards of NFPA are pertinent to fire investigation protective clothing. NFPA 1033, *Standard for Professional Qualifications for Fire Investigator* (NFPA, 1998b), makes specific demands of an investigator. One of these demands is investigators must meet designated requirements of NFPA 472, *Standard on Professional Competence of Responders to Hazardous Materials Incidents* (NFPA, 1997b). The referenced sections of NFPA 472, Section 2-2.1 through 2-2.3, contain information about training an individual to the *awareness level* of the standard. A person trained to that level is proficient in detecting the presence of hazardous materials and identifying information specific to the hazard. The information gained from the assessment of the scene is used to determine the level of hazard present. NFPA 472 then refers the reader to the *North American Emergency Response Guidebook* (United States Department of Transportation, 2000) to determine the appropriate safety precautions, including PPE, for each hazard.

NFPA 1033 (NFPA, 1998b) also refers the reader to NFPA 921, *Guide for Fire and Explosion Investigations* (NFPA 1998a), as a source of examples of protective clothing . The references to protective clothing in NFPA 921 are noticeably vague and refer only to "turnout gear or coveralls" and "hazardous environment suits" (p. 71). Appendix A of NFPA 921 does refer the reader to applicable occupational safety and health regulations "for additional information concerning safety requirements or training" (p. 146).

Two other NFPA standards encountered during the literature review were NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting* (NFPA, 1997c) and NFPA 1975,

Standard on Station/Work Uniforms for Fire and Emergency Services (NFPA, 1999). Both of these standards address issues related to PPE worn by fire suppression personnel, but neither directly address the special concerns of fire scene investigators. The station/work uniform requirements in NFPA 1975 emphasize flame resistance, an important consideration for fire suppression personnel, but not of major importance to the investigator who normally works when there is no remaining fire. NFPA 1971 presents the requirements for bulky, thermally protective structural firefighting PPE that is not necessarily conducive to prolonged fire scene investigations.

The Recommendations of Authoritative References

Most of the above discussion addresses fire scenes where hazardous materials may be present. In those situations the level of hazard will direct the type of protective clothing worn by the investigator. However, as noted in the *Fire Investigation Unit Management Guide*, "…most incidents do not generally involve hazardous materials or hazardous waste…" (MFRI, 1997, p. 8-9). In other words, the most regulated fire scenes represent only a minor part of fire scene investigations. Therefore, the available literature was also reviewed to see what recommendations are made concerning protective clothing at Level D fire scenes not known to contain hazardous materials. The literature review finds the literature considered as authoritative, and valued as quality educational material by investigators, is extremely limited when it comes to addressing Level D protective clothing.

Some authors like Phillips and McFadden (1996) provide no usable information since they make only short generic references to protective clothing for the investigator. DeHaan goes a little further in stating the need for "…protective clothing (simple overalls or synthetic fabric suits for hazardous material exposure)" (1997, p. 419). He also lists "denim coveralls" and

"disposable chemical exposure suits and shoe covers (e.g., Saranex)" (p. 447) as needed items for an investigator. Fitch and Porter mention the protective clothing of investigators should be "up to date OSHA and NFPA approved equipment" (1997, p. 24). They further state investigators must dress in the same protective gear as firefighters if the fire is still in progress when the investigator arrives. IFSTA'S *Introduction to Fire Origin and Cause* (IFSTA, 1997, p. 18) makes only a limited reference to appropriate personal protective clothing but does recommend using firefighting bunker gear compliant with NFPA 1971.

One article did address issues more relevant to fire investigation protective clothing. Williams (1997, p. 13) refers to "tear-resistant coveralls" and "a good quality set of knee pads" as advisable equipment. He notes that "slip, trip, and fall hazards abound" (p. 13) and seems to have a true grasp of hazards faced by an investigator. Williams also addresses the issue of weather-induced stress for the investigator and recommends choosing protective clothing accordingly.

Two articles spoke, in part, about the characteristics of different materials used in the manufacture of protective clothing. One noted that flame resistant materials were hot and added to heat stress problems (Gammel & Hansen, 1999). Lacy noted that cotton fabric is an asset at scenes because cotton will help alleviate the problem of static electricity when working around combustible or flammable vapors (1995, p. 4).

Literature Review Summary

The literature review reveals both the OSHA Federal Safety Standards and the NFPA Voluntary Consensus Standards apply to protective clothing for fire scene investigators. The manner in which the standards apply is more on an "inclusive" rather than "specific" order. The standards, with the exception of NFPA 1033, do not specifically refer to fire investigators, but

the intent is clear that fire investigators are included within the scope of the regulations. In scenes containing hazardous materials, the type of protective clothing worn is dictated by the standards. The standards apply in a much less significant way to fire scene investigations when a determination is made that no hazardous materials are present and Level D protection is adequate.

The published literature does address Level D protective clothing for fire scene investigators but mostly in a disappointing and generic way. References are made to coveralls and coats but with no detailed description of those items (DeHaan, 1997, pp. 419, 447; Fitch & Porter, 1997, p. 24; IFSTA, 1997, p. 18; Phillips &McFadden, 1996, p. 215). This researcher did not find one published book or article that extensively addresses the issue of what would be desirable design features to incorporate into a protective clothing ensemble for fire scene investigators.

PROCEDURES

Research Methodology

This research project utilizes an action research methodology to examine the issue of criteria for the selection of protective clothing for fire scene investigators. The research consists of a review of the pertinent published literature and the use of a survey instrument sent to other agencies involved in fire investigation. The survey instrument questions those agencies about their protective clothing policies and selection procedures. The results of this research will be used to determine the protective clothing options available to the Tulsa Fire Department fire investigators.

Literature Review

The research began with an examination of the relevant documents at the Learning Resource Center at the National Fire Academy in Emmitsburg, Maryland. This research started in late July 2000. The review of available literature continued at the Tulsa Fire Department in Tulsa, Oklahoma. The documents reviewed included periodicals, papers, and authoritative books. The research focuses on sources addressing fire investigation, fire scene safety, uniforms for the fire service, and the nationally recognized standards.

Survey Instrument

One of the objectives of the research is to determine what criteria other agencies are using for the selection of their fire scene investigation protective clothing. A cover letter (Appendix A) and a survey instrument (Appendix B) were prepared to investigate what other agencies are presently using as selection criteria. The survey was mailed on November 1, 2000, to 88 fire departments across the United States. The selected cities have a population of over 100,000. This minimum population was chosen in order to obtain input from organizations sufficiently large enough to have personnel specifically assigned to fire investigation duties. Forty-nine responses were received by December 1, 2000. All respondents indicated their organization performed fire scene investigations and therefore the data should be relevant.

The survey consisted of eight questions. The questions addressed several issues pertaining to protective clothing for fire investigators. Questions asked include whether the responding agency requires fire investigators to wear prescribed uniform or protective clothing and whether the person responding to the survey feels the clothing adequately addresses investigator safety. The respondents are also asked who makes the determination as to what protective clothing will be worn by investigators at different types of incidents. Also requested

was input about what type of protective clothing is presently worn by the agency's investigators and did the respondent feel the selection is based on the requirements of the nationally recognized standards. Finally, the respondents are asked to rank the importance of different criteria in determining the selection of the protective clothing for fire scene investigators.

Assumptions and Limitations

The information obtained from the referenced periodicals and textbooks is taken as authoritative and unbiased. It is assumed the respondents to the survey instrument did so in an informed, truthful, and objective manner. Also, it is assumed cities having a population in excess of 100,000 people will have personnel specifically assigned to fire scene investigation.

Limiting factors affecting this research include dated material from periodicals, a lack of literature addressing the issue of protective clothing specifically designed for scene investigation, a relatively small number of agencies sampled, and the limited scope of the research.

Some of the articles in the literature review are utilized in this research even though the material is sufficiently dated, up to five years, to be considered non-current. This material is retained and included due to its relevance to the research and the limited number of references available.

The periodicals and textbooks noted in the literature review have, for the most part, only limited references to protective clothing intended for investigating fire scenes not involving hazardous materials. No specific design, style, or type of protective clothing is recommended and the benefits of wearing one type of protective clothing versus another are also not presented. Fire scenes having a greater hazard present, and therefore requiring a greater level of protective clothing, are more sufficiently addressed in the literature and the national standards. There is a

tendency for the literature to refer only to the level of protection required and make no reference to any specific material, design, or features of the protective clothing.

The scope of this research is limited to the outer protective clothing worn to cover the torso and limbs of an investigator. This research did not consider protection for the head, foot, eye, hand, or respiratory system, although all of these deserve consideration in the selection of a complete ensemble of PPE.

Another limitation of this research is no input was solicited from the manufacturers of PPE for fire related activities to determine what protective clothing is currently available for fire investigation.

Eighty-eight surveys were sent to agencies involved with fire scene investigation. This is a relatively small number as compared to the actual number of such agencies across the country. The actual number would be sufficiently large to have warranted more agencies included in the survey. Also, only 49 completed surveys were returned. This represents a response rate of approximately 56 per cent, which is below the expected response rate of near 80 per cent.

Definition of terms

Awareness Level. Training level of a first responder who can recognize the presence of hazardous materials, protect themselves, call for trained personnel, and secure the area (NFPA, 1997b).

BDU. Acronym for “Battle Dress Uniform”. A two-piece shirt and pant ensemble with large pockets for storage. Usually made from cotton.

Bunker Gear. A term used to describe structural firefighting protective clothing.

Hazardous Materials (Haz-Mat). A substance (solid, liquid, or gas) that when released is capable of creating harm to people, the environment, and property (NFPA, 1997b).

Personal Protective Equipment (PPE). The equipment provided to shield or insulate a person from the chemical, physical, and thermal hazards that can be encountered at a hazardous materials incident. PPE includes both personal protective clothing and respiratory protection. Adequate PPE should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing (National Fire Protection Association, 1997b).

Protective Clothing. For the sake of this applied research project, protective clothing refers to the PPE intended to protect the torso and limbs of an investigator while conducting fire scene investigations.

Risk Assessment. An evaluation of the hazards present at a scene prior to the commencement of fire department operations.

Risk Management. Identification and analysis of exposure to hazards, selection of appropriate risk management techniques to handle exposures, implementation of chosen techniques, and monitoring of results, with respect to the health and safety of members (NFPA, 1997a).

Saranex. A brand name of a type of protective clothing providing protection against chemical splash.

RESULTS

Survey Instrument and Results

A survey instrument is utilized in this research to obtain criteria for selecting protective clothing from agencies actively involved in fire investigations. The survey respondent is asked for information regarding their agencies present protective clothing options for fire investigators, who determines what protective clothing will be worn at a particular incident, what is the basis

for that decision, and what are important criteria for selecting protective clothing specifically for fire investigators.

The results of the individual survey questions are included in the following discussion of the findings for the research questions. A copy of the cover letter, survey instrument, and detailed survey results are included in Appendixes A, B, and C, respectively.

Answers to Specific Research Questions

Research Question 1. Do the nationally recognized standards for fire department operations address the issue of protective clothing for fire scene investigators?

NFPA 1033 (NFPA, 1998b) and NFPA 1500 (NFPA, 1997a) both address the issues of protective clothing for fire scene investigators. NFPA 1033 directly refers the investigator to NFPA 472 (NFPA, 1997b, sections 2-2.1 through 2-2.3) where the investigator is required to be knowledgeable in the recognition of hazardous materials at fire scenes. The same sections of NFPA 472 require knowledge of how to use the *2000 Emergency Response Guidebook* to determine what protective equipment is required for the hazard. NFPA 1500 indirectly leads the investigator in the same direction by requiring a risk assessment of all fire department functions (NFPA, 1997a, section 2-2). The risk assessment requires the same determination as to whether hazardous materials are present as is found in NFPA 472. If present, then appropriate protection to hazards must be provided by the department (NFPA, 1997a, section 5-1.1).

In addition to the above, NFPA 1033 also directs the investigator to NFPA 921 (NFPA, 1998a). NFPA 921 only makes vague references to “proper safety equipment” which includes “protective clothing” (p. 71), but refers the reader to “appropriate local, state, or federal occupational safety and health regulations” (p. 146).

The Oklahoma Department of Labor has adopted federal OSHA regulations pertaining to safety and health, specifically 29 CFR 1910, *Federal Occupational Safety and Health Standards for General Industry* (Oklahoma Department of Labor, 2000, Section 380:40-1-2). Following the requirements of 29 CFR 1910.120, also known as Hazwoper, the investigator must be trained and certified to recognize and appropriately protect against hazards present at a scene (OSHA, 1994b).

The *Fire Investigation Unit Management Guide* discusses the potential for other OSHA standards to apply to fire scene investigation (MFRI, 1997). The standards that may be applicable to protective clothing considerations are *Personal Protective Clothing* (29 CFR 1910.132-1910.138), *Electrical Safety Work Practices Standard* (29 CFR 1910.331-1910.335) and *Bloodborne Pathogens Standard* (29 CFR 1910.1030) (as cited in MFRI, 1997, pp. 8-10, 8-11). These standards address specific situations that may arise at some fire scenes, but will not necessarily pertain to each investigation.

Question six of the survey instrument inquires whether the responding agencies base their selection of protective clothing for fire scene investigators on nationally recognized standards. Twenty-one of the respondents replied that they do base the selection on nationally recognized standards. Twenty-seven responded they do not. One response indicated the coveralls worn by that agency do not meet the standards but the other protective equipment utilized by the agency does.

In summary, the research found both NFPA and OSHA standards specifically address protective clothing for fire investigators by requiring a mandatory level of protection for a determined hazard level. However, less than half of the agencies responding to the survey

instrument indicated their agency based the selection of protective clothing on a nationally recognized standard.

Research Question 2. What are the recommendations of authoritative references for fire scene investigation concerning appropriate protective clothing for fire scene investigators?

Many of the authors found in the periodicals, papers, and textbooks for fire investigation make references to protective clothing for fire scene investigators. However, the references vary greatly in the amount of detail to the subject. Several authors (IFSTA, 1997; IFSTA, 2000; Phillipps and McFadden, 1996; Churchward, 1995; Geraci, 1997; and MFRI, 1997) make only very general statements about wearing coveralls, bunkers, or coats while investigating a fire. Others make more detailed recommendations. DeHaan (1997) adds clothing providing protection from hazardous materials may be required. Fitch and Porter (1997) note full firefighting protective gear is required if a fire is still burning when an investigator arrives at a scene.

Two of the published articles reviewed went into the subject more thoroughly, yet stopped short of making specific recommendations about design features or appropriate styles of protective clothing. Williams (1997) details hazards present at a fire scene and makes reference to how those may affect the fire investigator. He refers to the abundance of “slip, trip, and fall hazards” at a fire scene and recommends “a tear resistant coverall” and the need for “knee protection” (p. 13). Lacy (1995) takes the issue of protective clothing a step further by realizing all investigators do not wear the same clothing but each should protect their bodies from liquid splash at a fire scene. He also states it is easier to remove unneeded clothing than to suffer the consequences of under-protection (p. 2). Lacy is also the only author to note that 100% cotton clothing will help reduce the danger a static electric shock in a hazardous scene (p. 4).

A similarity between most authors reviewed is although they make no reference to what would be desirable features in protective clothing for investigators, they do reference following the recommendations of nationally recognized standards to determine the level of protection required at a scene. Williams (1997), MFRI (1997), Lacy (1995), IFSTA (2000), Churchward (1995), Geraci (1997), and Fitch and Porter (1997) all make references to the need to consult the national standards for information about determining the hazard, and therefore the level of protective clothing needed for fire investigations.

Mike Mallory, Safety Officer for the Tulsa Fire Department, informed this researcher he considers fire department bunker gear as Level C protection in some instances. The individual scene will determine if more chemical protection is required than the bunker gear can provide. Coveralls provide only Level D protection (M.J. Mallory, personal communication, October 25, 2000). Mallory also stated he has found no references which label bunkers, coveralls, BDU's, etc. as providing a specific level of protection. Instead, the protective level of the clothing item must be determined by evaluating the protective characteristics of that particular item.

Research Question 3. What are the fire investigators from other agencies using for protective clothing during fire scene investigations?

No published information on this subject was found in the literature review. However, the survey instrument included questions that are relevant to this research question. In response to survey question one, all 49 responding agencies answered they do perform fire scene investigations so the input from those respondents should be valid. Survey question two asks if the responding agency requires their fire scene investigators to wear specified uniform or protective clothing for fire scene investigations. Thirty of the respondents indicated their agency

did specify the protective clothing their fire investigators wear. Nineteen respondents indicated they did not and therefore the decision is up to the individual investigator.

Survey question four asked who made the determination as to what protective clothing is worn at fire scenes not containing known hazardous materials. Eighteen respondents replied the investigator, without assistance from others, made the decision as to what protective clothing to wear. Eleven responded the lead investigator, or the investigator with the assistance of a supervisor or safety officer, made the determination. A protective clothing decision made by someone other than an investigator at the scene accounted for 15 responses. Those decision-makers included chiefs of the department, chiefs of the division, and others not directly involved in fire investigation. Finally, five responses indicated the selection of protective clothing for the investigator is made based on a department policy or national standard.

Survey question five asked for the same information as in question four except, in this instance, the response is for the selection of protective clothing in fire scenes that do contain some level of hazardous materials. Only ten responses indicated the investigator was involved in the protective clothing decision. Incident Commanders, Safety Officers, or Hazardous Materials (Haz-Mat) Officers are likely to be involved when a hazardous material is present and, in many responses, the selection of appropriate protective clothing is made without any participation from the investigator.

Survey question seven also relates to research question three. Question seven asked the respondent for a description of what protective clothing is worn by their investigators while conducting fire scene investigations. In most cases the responses included a variety of protective clothing choices. A condensed summary of the responses shows 36 of the agencies provided fire department bunkers for use by the investigators. Flame resistant coveralls were noted in 7

responses and cotton coveralls were listed 23 times. Three agencies utilize BDU's as part of the fire investigators protective clothing. Six require the investigator wear a station/work uniform. Only one responding agency noted "street clothes" as an acceptable choice for use in fire investigation.

Research Question 4. What criteria are other organizations involved in fire investigation using to select protective clothing for fire scene investigators?

No published information was found in the literature review, but the survey instrument contained three questions relevant to this research question.

Question three asked whether the person responding to the survey felt the protective clothing policy of their agency adequately addresses the issue of investigator safety. Thirty-four of the respondents felt their policy does adequately address safety. Fifteen indicated they do not.

Survey question eight asked for the opinion of the respondent as to what they felt were the most influential criteria in selecting protective clothing for fire scene investigations. The respondents were asked to rate a number of factors on a scale indicating their importance. A summation of the responses shows *safety* is the most important factor to the respondents. Also rated highly are *mobility*, *comfort*, and *type of material*. These are followed in order by *availability*, *cost*, *utility*, and *flame resistance*. The factors deemed least significant by the respondents are *agency recognition* and *tradition*.

The respondents to survey question eight were asked to include additional factors they felt were significant. Only one response included an additional factor which was *toxic permeability*. This response is an important addition since it addresses the issue of hazards at fatality fire scenes mentioned in the *Fire Investigation Unit Management Guide* (MFRI, 1997, pp. 8-10, 8-11).

Final Product

The final product of this research is a recommendation sent in the form of an internal memo to the Fire Marshal of the Tulsa Fire Department (Appendix D). The memo recognizes the results of the research and makes recommendations to the Fire Marshal. The recommendations are for the department to provide the necessary training and protective clothing required by the relevant national standards. The final product also notes additional research is necessary to identify sources of protective clothing which meet Level D criteria.

DISCUSSION

The results of the study clearly found the nationally recognized standards do apply to protective clothing for fire scene investigations. A review of the standards reveals both the Federal OSHA and the NFPA Voluntary Consensus Standards have sections which are applicable to protective clothing for investigators. The review of the standards also reveals the references are extensive. The references tend to lead from one standard to another to obtain a flow of pertinent information.

NFPA 1033 (NFPA, 1998b) is directed to the qualifications of a fire investigator. That document refers to specific sections of NFPA 472, which require training the fire investigator to the "awareness level" of the standard. This enables an investigator to correctly identify and respond to hazards at a scene (NFPA, 1997b). The result of the recognition of a hazard is the selection of appropriate protective clothing for the scene.

Another document referenced by NFPA 1033 is NFPA 921, which contains sections recommending an investigator wear protective clothing (NFPA, 1998a, p. 71). NFPA 1500

requires a risk management plan for all fire department activities (NFPA, 1997a, section 2-2). The risk management plan of NFPA 1500 will require the same identification of hazards as found in NFPA 472, and therefore prescribe the level of protection needed for the fire scene investigators.

The literature review found NFPA 1033 opens the door for OSHA standards to apply by referencing the need to include regional and national safety standards in departmental policies (NFPA, 1998b, section 3-1.2). In Oklahoma, the federal OSHA standards are adopted into state safety and health standards through the Oklahoma Occupational Health and Safety Standards Act (Oklahoma Department of Labor, Rev. 2000, 380:40-1-2).

The OSHA standard which sets forth the requirements for the use of PPE by all fire fighters, including fire investigators, is OSHA 1910.120, also known as "Hazwoper" (OSHA, 1994b). Although fire investigators are not addressed specifically, the standard requires certain actions on the part of any individual at a potentially hazardous scene and therefore includes the investigator within its scope.

This researcher noted some, but not all, of the authors reviewed recognized the relationship between the national standards and required protective clothing for fire scene investigators. Howics (1995) devotes an entire research paper to the topic of how OSHA regulations apply to fire scene investigators, specifically OSHA 29 CFR 1910.120 (OSHA 1994b). The *Fire Investigation Unit Management Guide* (MFRI, 1997) provides an extensive account of how several of the OSHA and NFPA standards are applicable.

Other authors make some reference, although to a lesser extent than the authors mentioned in the previous paragraph, to the applicability of the standards to fire investigation.

IFSTA (2000), IFSTA (1997), Fitch and Porter (1997), and Lacy (1995) all refer the reader to a standard for additional information about protective clothing.

Although the standards form a complex chain of references from one to another, the end result is the standards apply to the criteria for selecting protective clothing for investigators and the findings of others verify that conclusion. The implication is the Tulsa Fire Department must follow the requirements of those standards. Another implication is all investigators need to be Hazwoper and NFPA 472 certified.

The results of the study produced disappointing results in the area of research question two. The recommendations of authoritative references for fire scene investigation address the topic of protective clothing in a generic vagueness which is less than helpful for an agency trying to determine selection criteria. One of the most significant statements found during the research is a short phrase reminding the reader that only a small portion of fire scenes contain hazardous materials (MFRI, 1997). This important point, that the vast majority of scenes investigated by fire investigators do not involve identified hazardous materials, is overshadowed by the amount of literature addressing the requirement for Level A, B, or C protective clothing as established in the standards. In scenes involving those levels of protection, there is very little choice left to the investigator since the protective clothing must meet the requirements of the scene. However, Level D scenes, which account for the majority of fire scenes, require only “a work uniform affording minimal protection: used for nuisance contamination only.” (OSHA, 1994a, p.4).

For the most part the findings of others avoid making specific references or recommendations about any desirable features, materials, or improvements concerning Level D clothing. From this researcher’s personal experience in fire investigation, it is evident improvements are needed in the areas of protection, comfort, mobility, and utility to name a few.

Geraci (1997) noted investigators are often forgotten by the other fire department functions at a scene (p. 51). From the results of the research it appears the same is true of Level D protective clothing provided for investigators.

Williams (1997), Lacy (1995), and Gammel and Hansen (1999) were three of the sources that did point out desirable features of protective clothing for fire investigators. The need for knee protection, tear resistant materials, liquid splash protection, and clothing addressing heat and cold issues were discussed. Geraci (1997) also noted the need for seasonal protective clothing considerations such as insulated coveralls and cool vests.

Other authors offer little in the way of recommendations for protective clothing. IFSTA (2000), IFSTA (1997), DeHaan (1997), Phillipps and McFadden (1996), Fitch and Porter (1997), and MFRI (1997) contain no specific references to desirable or recommended Level D protective clothing.

In general, the topic of appropriate protective clothing for fire scene investigators is poorly addressed by the authoritative references once the need for hazardous material protection is not a factor. The implication for the Tulsa Fire Department is other sources of input, such as the survey instrument utilized in this research, must be considered for determining pertinent criteria for the selection of protective clothing for fire investigators.

Research question three addresses the issue of what other agencies involved in fire investigation are utilizing as protective clothing. The results of the survey instrument (Appendix C) show fire investigators are wearing a variety of protective clothing. The responses do not show strict adherence to the terminology used in the standards. In fact, only one of the survey respondents mentioned a *level* of protection used in the selection of their protective clothing. From the responses, the standard procedure for most agencies is to issue bunker gear and a lower

level of protection (coveralls or BDU's) for use by the investigator. Protective clothing for a level of protection more stringent than bunker gear was mentioned in only one survey response.

The implications of the research are a variety of protective clothing is needed to provide proper levels of protection for fire investigators.

Research question four inquires what criteria are used by other fire investigation organizations to select protective clothing for their investigators. Many (28 of the responding 49 agencies) indicated they do not base the selection of protective clothing for fire investigators on any recognized standard. Interestingly, the protective clothing worn by those agencies did not dramatically differ from the clothing worn by agencies that said they did base their selection on the national standards.

Many of the survey respondents did not cite a specific standard number and replied only that either OSHA or NFPA was the basis for the selection of protective clothing. Some of the respondents stated their selection of protective clothing is based on national standards, but the particular standards given as reference are not appropriate. Examples include those who state their protective clothing is based on NFPA 921, which is very non-specific and refers the reader to other documents to obtain information on protective clothing. Another respondent listed the only protective clothing used by the agency as "bunker gear" but cited NFPA 1975, the standard for station/work uniforms as the referenced standard. Finally, another example of a misunderstood reference is a respondent listing NFPA 1500 as the basis for their protective clothing selection. NFPA 1500 requires the use of protective clothing but refers the reader to other standards to determine the specifications of the clothing.

Survey question eight asks the respondents to rate several criteria in order of importance in selecting protective clothing. The average rating for each response is given in Appendix C,

question eight. Safety was the number one rated criteria. Mobility, comfort, and type of material also rated highly. Interestingly, the categories of tradition and agency recognition were deemed least important even though firefighting is deeply tied to tradition and pride.

An implication of the research is a majority of the agencies do not realize they are bound by the requirements of the nationally recognized standards when selecting protective clothing for fire investigators. Investigators unaware of these requirements may be inadequately protected at fire scene investigations. An implication of the survey results is the selection of protective clothing for the Tulsa Fire Department investigators should address the specific needs of fire investigation. Also, the department should recognize the applicability of the national standards in determining appropriate protective clothing

RECOMMENDATIONS

The research results identified criteria useful in the selection of protective clothing for fire scene investigators. The results also indicate the need for several positive actions by the Tulsa Fire Department.

First, since the research finds the nationally recognized standards do pertain to protective clothing for fire scene investigators, efforts must be made to comply with those standards. The research finds the national standards require fire scene investigators to be trained to the *awareness level* of NFPA 472. The results also indicate fire investigators must be adequately trained to the requirements of OSHA's Hazwoper. The fire department should immediately initiate efforts to gain compliance to the standards. Compliance with the standards resolves issues of investigator safety and department liability.

The research identified how other agencies from across the country ranked the importance of protective clothing criteria. Those criteria should be incorporated into the future selection of protective clothing provided to Tulsa Fire Department investigators. Such action will again address investigator safety issues. Protective clothing which is both job specific and functional will provide an additional tool for fire investigators to accomplish their tasks.

A limitation of the research is the manufacturers of protective clothing for fire department operations were not solicited for information pertaining to protective clothing for fire investigators. More research should be conducted using the criteria identified in the survey instrument to determine if manufacturers can provide protective clothing products addressing the specific requirements of fire investigators.

The fire department should provide fire investigators with an assortment of protective clothing appropriate for personal protection to Level B, C, and D hazards. The use of Level A protective clothing is beyond the scope of training provided to Tulsa's fire investigators. A variety of protective clothing affords the investigator both protection and the ability to perform a quality fire scene investigation. The provided clothing should address the seasonal considerations for excessively hot and cold conditions since both are encountered in the Tulsa, Oklahoma climate.

Finally, the recommended changes for the selection of protective clothing for fire investigators will be submitted to the Fire Marshal of the Tulsa Fire Department for policy change consideration. The expected results will be the incorporation of those recommendations into the Administrative Operation Procedures of the department.

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APPENDIX A

Survey Cover Letter

November 1, 2000

Enclosed is a survey that is part of an Applied Research Project for the Executive Fire Officer Program at the National Fire Academy. Your cooperation in completing the survey is requested and greatly appreciated. The survey can be completed by anyone in the Fire Investigation Division of your department.

The person completing the form needs to have knowledge of any policies and procedures dictating what protective clothing or uniform is worn by personnel when conducting fire scene investigations for your department.

The purpose of the Applied Research Project is to identify criteria for the selection of protective clothing for Tulsa Fire Department fire scene investigators. Unlike fire suppression protective clothing, which is now stringently controlled by nationally recognized standards, fire investigators have less direction when it comes to selecting protective clothing.

This survey will identify what types of protective clothing other departments are using and how they have made their selections.

Again, I sincerely appreciate your input and I thank you in advance for your time.

Please return the survey by fax to: Chief David Hayes
(918) 596-1897

Or, if you would prefer, by using the enclosed return envelope.

Thank you.

APPENDIX B

Survey of Fire Investigation Agencies
Establishing Criteria To Select Protective Clothing for Fire Scene Investigators

State:_____ Agency:_____

1. Do members of your agency perform fire scene investigations?

Yes ☐ No ☐ If no, please return this survey **without** continuing further.

2. Are your fire investigators required to wear specified uniform or protective clothing while conducting their fire scene investigations?

Yes ☐ No ☐

3. Do you feel your present protective clothing policy adequately addresses the issue of investigator safety?

Yes ☐ No ☐

4. Who makes the determination as to what standard protective clothing will be worn by fire scene investigators at a fire scene <u>not</u> known to have hazardous materials present?

_____

5. Who makes the determination as to what standard protective clothing will be worn by fire scene investigators at a fire scene suspected of <u>containing</u> some level of hazardous materials?

_____

6. Is the selection of your protective clothing for fire scene investigations based on a nationally recognized standard such as NFPA, OSHA, etc.?

Yes ☐ No ☐ If yes, which one(s)?

_____

7. Briefly describe the different types of outer protective clothing worn by your investigators at a fire scene. Please include the material type. For the purposes of this survey, include only the outer protective clothing worn. Do not include head, eye, foot, or respiratory protection.

_____
_____
_____
_____
_____
_____
_____

8. Which of the following would you say has most influenced the selection of protective clothing for your fire scene investigators? Please rate each of the following factors from one to five by circling the appropriate number. A one indicates the item was not important to your decision and a five indicates the item was an influential concern in the selection process.

	Not important……Important				
Comfort	1	2	3	4	5
Availability	1	2	3	4	5
Type of material	1	2	3	4	5
Mobility	1	2	3	4	5
Safety	1	2	3	4	5
Cost	1	2	3	4	5
Utility	1	2	3	4	5
Flame resistance	1	2	3	4	5
Agency Recognition	1	2	3	4	5
Tradition	1	2	3	4	5
Other _____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

I sincerely thank you for your valuable time and appreciate your input into this research. Please fax your completed survey to Chief David Hayes at (918) 596-1897. Or, return the survey in the enclosed envelope.

APPENDIX C

Survey Results

1. Do members of your agency perform fire scene investigations?

Yes 49 No 0

2. Are your fire investigators required to wear specified uniform or protective clothing while conducting their fire scene investigations?

Yes 30 No 19

3. Do you feel your present protective clothing policy adequately addresses the issue of investigator safety?

Yes 34 No 15

4. Who makes the determination as to what standard protective clothing will be worn by fire scene investigators at a fire scene not known to have hazardous materials present?

Investigator	18	Chief of Arson	1
Lead or Chief Investigator	3	Safety Officer	3
Investigator or Supervisor	5	Chief or Safety Officer	1
Investigator w/Supervisor Approval	2	Department Policy	3
Investigator and Safety Officer	1	OSHA	1
Chief Fire Marshal or Fire Marshal	3	Bureau of Fire Investigation	1
Chief of Department	2	Deputy Chief of Fire Prevention	1
Incident Commander	4		

5. Who makes the determination as to what standard protective clothing will be worn by fire scene investigators at a fire scene suspected of <u>containing</u> some level of hazardous materials?

Investigator	5	Chief of Safety Officer	1
Investigator w/Safety Officer, Incident Commander, or Haz-Mat Officer	5	Chief of Arson	1
Incident Commander	10	Chief Fire Marshal	1
Incident Commander w/Haz-Mat	2	Fire Marshal	1
Safety Officer	5	Director of Fire Prevention	1
Safety Officer w/ Haz-Mat	1	Haz-Mat Personnel or policy	7
Safety Officer w/Incident Commander	1	Haz-Mat with other input	6
Chief of Department	2		

6. **Is the selection of your protective clothing for fire scene investigations based on a nationally recognized standard such as NFPA, OSHA, etc.?**

NFPA (Non-specific)	8	NFPA 1971	1
NFPA 921	3	NFPA and OSHA (Non-specific)	4
NFPA 1975	1	OSHA (Non-specific)	2
NFPA 1500	2	"Yes" with no standard given	1

7. Briefly describe the different types of outer protective clothing worn by your investigators at a fire scene. Please include the material type. For the purposes of this survey, include only the outer protective clothing worn. Do not include head, eye, foot, or respiratory protection.

Bunkers only	7	Bunkers and Tyvex	1
Coveralls only	4	Bunkers and Station wear	5
Bunkers and BDU's	3	Bunkers, Coveralls, Station wear	5
Bunkers and Cotton Coveralls	15	Street clothes	1
Bunkers and Fire Resistant Coveralls	4	Fire resistant and non-fire resistant coats and coveralls	1

8. **Which of the following would you say has most influenced the selection of protective clothing for your fire scene investigators? Please rate each of the following factors from one to five by circling the appropriate number. A one indicates the item was not important to your decision and a five indicates the item was an influential concern in the selection process.**

Safety	4.36
Mobility	4.22
Comfort	3.90
Type of material	3.71
Availability	3.47
Cost	3.16
Utility	3.14
Flame resistance	3.12
Agency recognition	2.82
Tradition	1.94
Other- Toxic permeability (One response rating this factor as very important)	

APPENDIX D

Recommendation to Fire Marshal

Internal Memo
To: Chief Allen LaCroix, Tulsa Fire Marshal
From: David Hayes, Chief of Investigations
Date: 01/05/01
Re: Fire Investigator Protective Clothing Selection Criteria

The following recommendations are the result of an Applied Research Project completed as part of the requirements for the Executive Development course offered at the National Fire Academy in July of 2000.

The problem addressed by the research was the Tulsa Fire Department has no identified criteria for the selection of protective clothing worn by fire scene investigators.

The purpose of the research was to identify criteria for the selection of appropriate protective clothing for fire investigators. Consideration was given to the following topics: (a) do the national standards apply to fire investigator protective clothing, (b) does the published literature address the issue of appropriate protective clothing for fire investigators, and (c) what are other agencies involved in fire investigation using as criteria for the selection of protective clothing for fire scene investigators.

The research found the national standards do address the issue by requiring risk assessments at all fire department operations. The risk assessment determines the level of the hazard present and therefore the required protective clothing for the fire scene investigation. The standards also require the investigator be trained in the use of the protective equipment utilized. NFPA 472 requires the investigator be trained to the "awareness level" of the standard in order to assure hazards are properly identified and protected against. OSHA's 1910.120 requires the investigator be "Hazwoper" certified to accomplish the same objective. It is therefore recommended we provide this training to the Tulsa Fire Investigators.

The levels of required protection will dictate the protective clothing worn by investigators unless no identified hazard is present at a scene. Most scenes have no identified special hazard. In those scenes the selection of protective clothing is at the discretion of the department. The fire department currently supplies fire investigators with bunker gear, fire resistant coveralls, and insulated coveralls. It is recommended the fire department continue to supply those levels of protection but the department should supplement that protective clothing to ensure protection to any hazard present at a scene. Most notable is the need to provide investigators with chemical protective clothing.

Other agencies supplied input into the research by describing the criteria deemed most important in the selection of protective clothing for fire investigators in non-hazardous scenes. The responding agencies indicated the following were the most important criteria (in descending order of importance): safety, mobility, comfort, type of material, availability, cost, utility, flame resistance, agency recognition, and tradition. Toxic permeability was also noted. Since the research did not identify sources for the protective clothing, it is recommended the Tulsa Fire Department continue research into finding a supplier that can provide protective clothing exhibiting the above criteria in order of importance.

Finally, it is recommended the results of this research be recognized as influential in determining the requirements for selecting protective clothing for fire investigators and the policy for the selection of that clothing reflects these findings.